The exam covers Ch3.8, 4.1-4.6, and 5.1-5.3. **My personal advice: be sure you can define the definite integral and state both parts of the fundamental theorem of calculus; these are very likely to be on the exam.** See also Prof. Mortensen's course review sheet on the course website.

Ch3.8: Related Rates

1. (# 8) Suppose a forest fire spreads in a circle with radius changing at a rate of 5 feet per minute. When the radius reaches 200 feet, at what rate is the area of the burning region increasing?
2. (# 9) A 10-foot ladder leans against the side of a building. If the bottom of the ladder is pulled away from the wall at the rate of 3 ft/s and the ladder remains in contact with the wall, find the rate at which the top of the ladder is dropping when the bottom is 6 feet from the wall.

Ch4.1: Antiderivatives

1. Find the general antiderivative:
   (a) $\displaystyle\int \frac{x + 2x^{3/4}}{x^{5/4}}\,dx$
   (b) $\displaystyle\int \frac{4}{\sqrt{1-x^2}}\,dx$
   (c) $\displaystyle\int \frac{e^x}{e^x+3}\,dx$
2. Find the function satisfying $f''(x) = 2x$, $f'(0) = -3$, $f(0) = 2$.
3. Find all functions satisfying $f'''(x) = \sin(x) - e^x$.

Ch4.2: Sums and Sigma Notation

On the exam, you will be given these formulas from p. 356.

> If n is any positive integer and c is any constant, then
>
> 1. $\displaystyle\sum_{i=1}^{n} c = cn$ (sum of constants),
> 2. $\displaystyle\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$ (sum of the first n positive integers), and
> 3. $\displaystyle\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$ (sum of the squares of the first n positive integers).

1. Compute $\displaystyle\sum_{i=1}^{250} \left(i^2 + 8\right)$.
2. Compute the sum and the limit of the sum as $n \to \infty$: $\displaystyle\sum_{i=1}^{n} \frac{1}{n}\left[4\left(\frac{2i}{n}\right)^2 - \left(\frac{2i}{n}\right)\right]$.

Ch4.3: Area

1. Use Riemann sums and a limit to compute the exact area under the curve: $y = x^2 + 3x$ on $[0, 1]$. **You may not use the fundamental theorem of calculus.** In other words, evaluate the definite integral $\displaystyle\int_0^1 x^2 + 3x\,dx$ from the definition.

2. True or false: if $f(x)$ is increasing on $[a, b]$, then a Riemann sum with right-endpoint evaluation will give you a value that is at least as large as the signed area under the curve $f(x)$ on $[a, b]$.

Ch4.4: The Definite Integral

1. State the integral mean value theorem.
2. Give upper and lower bounds on $\displaystyle\int_{-1}^{1} \frac{3}{x^3+2}\,dx$.

Ch4.5: The Fundamental Theorem of Calculus

1. State:
   (a) Part I of the fundamental theorem of calculus
   (b) Part II of the fundamental theorem of calculus
2. Compute the following.
   (a) $\displaystyle\int_0^2 \left(\sqrt{x}+1\right)^2\,dx$
   (b) $\displaystyle\int_0^{\pi/3} \frac{3}{\cos^2(x)}\,dx$
   (c) $\displaystyle\int_1^2 \frac{x^2-3x+4}{x^2}\,dx$
3. Find $f'(x)$: $f(x) = \displaystyle\int_{x^3}^{x^2} \sin(\sqrt{t})\,dt$.

Ch4.6: Integration by Substitution

1. Evaluate the indefinite integrals:
   (a) $\displaystyle\int \sin^3 x \cos x\,dx$
   (b) $\displaystyle\int \frac{x}{x^2+4}\,dx$
   (c) $\displaystyle\int \frac{2x+3}{x+7}\,dx$
   (d) $\displaystyle\int \frac{4}{x\left(\ln x+1\right)^2}\,dx$
2. Evaluate the definite integrals:
   (a) $\displaystyle\int_1^e \frac{\ln x}{x}\,dx$
   (b) $\displaystyle\int_0^2 x\sqrt{x^2+1}\,dx$
   (c) $\displaystyle\int_0^2 x\sqrt{x+1}\,dx$

Ch5.1: Area Between Curves

Sketch and find the area of the region bounded by the given curves. Choose the variable of integration so that the area is written as a single integral.

1. $x = y$, $x = -y$, $x = 1$
2. $y = 3x$, $y = 2 + x^2$

Ch5.2-5.3: Volumes

Compute the volume:

1. The region bounded by $y = x^2$ and $y = 2 - x^2$, revolved about $x = 2$.
2. The region bounded by $x = y^2$ and $x = 2 + y$, revolved about $x = -1$.

General Review

1. (a) Define the indefinite integral.
   (b) Define the definite integral.
   (c) How are these the two concepts related?